Evaluating Fire Service Operations in High Wind Conditions in the City of Greenville, North Carolina

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: ____

Abstract

The City of Greenville has a high risk of extreme wind conditions during hurricanes that affect the community. The problem is that the Fire/Rescue department does not have a policy that identifies when to restrict or cease operations during these extreme high velocity wind events. Because of this policy lapse, our members risk death or injury while working within these high wind environments, as well as exposing equipment to potential damage. This Applied Research was initiated to identify wind speeds and other factors that would necessitate suspending operations to prevent injuries and death to emergency responders.

The author used the descriptive research methodology to answer the following questions: What are the standards regarding operational limits in high wind situations relating to vehicles of various sizes? What are other Fire/EMS departments in hurricane prone areas utilizing to identify when to cease or limit operation(s) in high wind events? What criteria are utilized to determine when to suspend tactical firefighting operations in high wind events? What tools are other Fire/EMS departments employing to accurately measure sustained winds and to reach conclusions to suspend operations?

An electronic survey was distributed and the information obtained was analyzed along with information discovered in research activities by the author within this document. Based on the research results, the following recommendation involves the suspension of all response and operations at a sustained wind speed of 40 mph or greater. This standard should be developed/implemented within a local policy or procedure to keep emergency response personnel from being injured or killed in high velocity wind events.

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Introduction

The state of North Carolina has a long history of experiencing high wind events in the form of tropical cyclones or hurricanes, dating back to 1886, with records documenting the intensity. Since that time, there have been 951 tropical cyclones that have been recorded in the Atlantic Ocean and the Gulf of Mexico (North Carolina State University [NCSU], 2011). Approximately 166 or 17.5% of those tropical cyclones passed within 300 miles of North Carolina. Appendix A contains the number and percentage of tropical storms and hurricanes that made landfall in North Carolina, or made landfall in another state and later passed through North Carolina (NCSU, 2011).The coast of North Carolina can expect to receive a tropical storm or a hurricane once every four years, while a major tropical cyclone affects the state every 1.3 years (Barnes, 2001). North Carolina ranks fourth behind Florida, Texas, and Louisiana as hurricane prone states receiving the effects of these storms (NCSU, 2011). Loss estimates since 1970 indicate that North Carolina has experienced over 11 billion dollars in damage and over 1000 fatalities since 1889, due to these massive storms (NCSU, 2011).

Greenville Fire/Rescue department has experienced the effects of high winds during these tropical cyclone events 12 times since 1971 with ten of these storms producing wind speeds of 100 MPH or more (NCSU, 2011). The problem is that Greenville Fire/Rescue does not have a policy identifying when to suspend response or operations during these high wind events. This policy lapse has the potential to result in death or significant injury to personnel responding and operating in these extreme circumstances. The purpose of this research is to identify the appropriate response during these events and to determine when to suspend operations.

A descriptive research methodology was used to answer the following questions: a) What are the standards regarding operational limits in high wind situations relating to vehicles of various sizes? b) What are other Fire/EMS departments utilizing to identify when to cease or limit operation(s) in high wind events? c) What criteria are utilized to determine when to suspend tactical firefighting operations in high wind events? d) What tools are other Fire/EMS departments employing to accurately measure sustained winds and to reach conclusions to suspend operations?

Background and Significance

Greenville Fire/Rescue is a department in North Carolina that protects a population of 81,092 citizens that reside within a 34.88 square mile area of Pitt County (United States Census Bureau, 2010). The department is comprised of 157 members and six strategically placed stations. The department responded to 4,540 calls for emergency service in the calendar year 2009 (City of Greenville [COG], 2009). Of these calls, 2,182 involved a fire response, with a total of 83 single and multi-family residential structure fires (COG, 2009).

Greenville Fire/Rescue also has a Type Two, Federal Emergency Management Agency, Urban Search and Rescue [USAR] team, which is comprised of 48 members from within the department. All resources for this team and the equipment cache are housed within the department. The team responds to incidents as authorized by the Office of Emergency Management for the State of North Carolina (NCUSAR, 2011).

Hurricanes are a prominent threat within the state of North Carolina from June 1st through November 30th each year, which is considered the most active time for hurricane development within the Atlantic basin (Sheets & Williams, 2001). North Carolina is ranked fourth in susceptibility to a direct landfall of a hurricane, and, with 301 miles of coastline; the potential for extreme damage is prominent to this region (NCSU, 2010). The coast of North Carolina can expect to receive a tropical storm or a hurricane once every four years, which equates to the probability statistic of a 10 to 21 percent chance of landfall along with a 2.1 to 5.3 percent chance of a major hurricane impacting our state in any given year (Sheets & Williams, 2001). These percentages reflect the probabilities of a hurricane, with winds greater than 111 mph, passing within 75 miles of a given location within the state, and are a measure of the relative danger.

Injury potential during these extreme wind conditions can be assessed by the statistics relating to recorded storms that have occurred since 1889, which reflect over 1000 deaths in the state of North Carolina alone (Barnes, 2001). These storms not only hold significant potential to cause physical injury from extreme wind exposure, but also to bring the risk associated with the storm surge that accompanies a hurricane's landfall within a given area (Schwartz, 2007).

During the years between 2000 and 2005 16% of firefighter deaths occurred as a result of natural disasters (Fisher, McDonald, Merrell, Moore, and Zhou, 2006). This percentage encompassed the categories which included hurricanes, tornadoes, and flooding (Fisher et. al., 2006).

This research relates directly to the Executive Analysis of Fire Service Operations in Emergency Management course at the National Fire Academy and follows three of the five United States Fire Administration operational directives relating to:

- "Reducing the loss of life to firefighters" (USFA, 2008, Section II, p. 2)
- "To promote within communities a comprehensive, multi-hazard risk reduction plan led by the fire service organization" (USFA, 2008, Section II, p. 2)
- "To respond appropriately in a timely manner to emerging issues" (USFA, 2008, Section II, p. 2)

Literature Review

Hurricanes are defined as giant whirlwinds in which air moves in a large tightening spiral around a center of extreme low pressure (National Hurricane Center [NHC], 2011). Hurricanes are also referred to within the category of tropical cyclones in which the maximum sustained surface wind is 74 mph or greater (Schwartz, 2007). Since the early 1970's, the National Weather Service has used the Saffir-Simpson hurricane scale to measure and categorize a hurricane's potential for generating destructive tides and wind related damage (Schwartz,2007). This scale is divided into five levels, or categories, based on the destructive potential of the hurricane (Schwartz, 2007). Of these five levels, the most minimal is level one occurring when wind speeds reach a minimum of 74 miles per hour (mph), and incrementally increase to the maximum level of five where winds reach a maximum of greater than 155 mph (Sheets & Williams 2001). Hurricanes reaching category three or higher are considered major hurricanes because of their potential for loss of life and damage (International Association of Fire Chiefs [IAFC], 2008).

Measuring wind potential and its effects on individuals was observed and recorded on the Beaufort scale beginning in 1906 (Schwartz, 2007). This scale is an incremental measure used to estimate wind speed by visual observation, thereby requiring no equipment (Schwartz, 2007). It ranges in categories from zero (calm), to twelve (hurricane) (Schwartz 2007). The Beaufort scale encompasses the visual observations that a person experiences physically and is reflected in Appendix B. At a speed of between 39 and 46 mph a person's walk is affected and one's progress is impeded (Appendix B).

The "eye wall" is located within a hurricane, and contains the hurricane's highest winds, heaviest rain, and strongest thunderstorms (Sheets & Williams, 2001). Feeder bands are thunderstorms that spiral into and around the center of a hurricane, or tropical system, and carry heat and moisture which provides energy for a hurricane (Davies, 2000). These bands of humid air, clouds, and precipitation, form the dense wall of the clouds that surround the eye, or center, of the storm (Davies, 2000).

Hurricane season in the Atlantic basin begins each year on June 1st and lasts until November 30th (NHC, 2011). The Atlantic basin is identified as the Atlantic Ocean, north of the equator, the Caribbean Sea, and the Gulf of Mexico (Sheets & Williams, 2001).

Though hurricanes have the potential for death and injury at the major storm categories of three and above, according to the Saffir-Simpson scale, most fire departments do not adhere to a specific policy relating to suspension of efforts in providing assistance during these identified hazardous periods (IAFC, 2008). Moreover, the majority of fire departments that were surveyed within the scope of this research do not have identified guidelines relating to suspension of operations in extreme wind events.

Fire engines, ambulances, sport utility vehicles, and passenger cars are routinely employed by fire departments to respond to emergencies in all regions of the United States and remain in use in hurricane prone areas even during the height of impact from these storms. Wind speeds between 64 and 70 mph will cause a deviation in travel for a fire engine that has no equipment or water on board (Pirelli & Subramanian, 2003). Overturning of this type of unit is unlikely; however, a course deviation could cause a collision with another obstacle and cause the unit to overturn (Pirelli & Subramanian, 2003). The wind speed that is considered the benchmark for seeking shelter and suspending travel for fire engines is 70 mph (Pirelli & Subramanian, 2003).

Aerial ladder extension operations become dangerous and should be suspended when wind speeds reach 45 mph, according to research performed in 2004 (Fisher, 2004). Current limitations on 100 foot aerial ladders and longer reflect an operational suspension recommendation when wind speeds reach 50 mph or greater (Pierce & Sutphen, 2011).

Critical wind speeds can impact ambulance operation when 35-50 mph is reached (Pirelli & Subramanian, 2003). Furthermore, these units are at risk of overturning when wind speeds reach 90 mph and above (Pirelli & Subramanian, 2003). Winds also interrupt travel speeds by slowing the response of the ambulance, and it was found that a slower vehicle response speed increases the overturn speed to 100 mph (Pirelli & Subramanian, 2003). Similar to a fire engine, a course deviation can also cause an ambulance to collide with another obstacle and cause the unit to overturn. The wind speed that is considered the benchmark for seeking shelter and suspending travel for ambulances is 50 mph (Pirelli & Subramanian, 2003).

Sport utility vehicles become susceptible to high winds at 77 mph, with a risk of overturning at a wind speed of 138 mph (Pirelli & Subramanian, 2003). These vehicles can also overturn at a lower rate of speed in a course deviation or collision with another obstacle. Similar to fire engines, the benchmark speed recommended to suspend travel with these type vehicles is 70 mph (Pirelli & Subramanian, 2003).

Passenger vehicles have a susceptibility to sliding when exposed to wind speeds in excess of 71.5 mph (Greatrix, 2011). When winds directly impact this type of vehicle at a 90 degree angle, a wind speed gust of 80.8 mph can potentially cause it to overturn (Greatrix, 2011).

Existing road conditions, debris, driver experience, and tire tread can reduce or increase the impact of the dangerous wind conditions. These aspects must be taken into account when making decisions regarding operational safety levels for the personnel involved while traveling to a call for service during high wind situations (Pirelli & Subramanian, 2003). Another aspect that inhibits operational activities is the wind gusts which can be as much as 1.3 times faster than sustained winds (Sheets & Williams, 2001).

Personnel safety in these high wind environments presents further operational considerations. As stated earlier referencing the Beaufort scale, at a wind speed between 39 and 46 miles per hour or greater, a person's progress can be impeded when traveling on foot (Appendix B). This affects personnel and their ability to function effectively (Fisher, 2004).

Tactical firefighting operations change adversely when winds reach a sustained speed of between 20 to 25 mph (National Institute of Standards and Technology, [NIST] 2009). These identified winds do not necessarily impact the ability to perform various tactical functions on the emergency scene by personnel directly; however, they begin to impact the spread of fire in an aggressive manner that can require an Incident Commander to modify a variety of strategic decisions (NIST, 2009).

The National Weather Service provides "Spot Forecasting" meteorological information as an internet resource that can be useful to obtain specific sustained wind speed information for a given geographical area when making decisions regarding the manner of response (National Weather Service [NWS], 2011). This specific source of information provides consistency to emergency response personnel when making decisions regarding sustained winds in an identified area (NWS, 2011).

The information identified above reveals the various aspects pertaining to the realistic threat that these situations can produce and the effects on personnel and equipment during these particular high wind events.

Procedures

The procedures are reflective of a descriptive research method that was conducted with the assistance of various emergency response organizations. These organizations have a highly vested interest relating to the safety of their personnel, and the data obtained was analyzed within this research effort to provide the most current information possible for reference.

A problem statement, purpose, and research questions were reviewed for clarity, and submitted for approval by the assigned Executive Fire Officer Reviewer. This approval was obtained, and the applied research project was initiated.

A literature review was conducted, and was limited to materials and publications available from the Learning Resource Center from the National Fire Academy, Sheppard Memorial Library, and the internet during the period of January 2011 through May 2011.

A survey was created to gather information from the various stakeholders identified within this portion of the applied research (Appendix D). This survey was administered via email to the North Carolina Association Fire Chiefs on March 15, 2011. The survey was developed and the attempt was made to gather information relating to wind speeds and operational policies from various departments within the United States. It was reviewed for clarity and applicability by Greenville Fire/Rescue employees Battalion Chief Susan Barrett, Training and Safety; Captain Charles Owens, Emergency Medical Service Coordinator; and Lieutenant Brock Davenport, Shift 3 Officer. Each of these officers provided additional input regarding the clarity of the survey questions, and their applicability of purpose.

The limitations that were encountered involved the response to the electronic survey by North Carolina based fire departments exclusively. Attempts were made to contact other state's agencies utilizing the North Carolina Fire Chiefs Association; however, no feedback was provided from other states or related organizations. Therefore, from a national perspective, the resulting information lacks the broad perspective that was desired by this author.

Results

A survey was administered via email to evaluate the parameters that are presently employed to make response and operational decisions relating to calls for service by Fire and EMS departments (Appendix D). The responses were collected over a 30 day period and are summarized with the following response limitations, because all 59 responses that were received were from Chief level officers within North Carolina Fire/EMS departments. This represents approximately six percent of the total number of fire departments within North Carolina. The respondents provided information from an identified geographical location area between Asheville, North Carolina to Jacksonville, North Carolina. Charlotte Fire Department (NC) was the largest department to respond and Winterville Fire Department (NC) was the smallest department to participate.

The majority of the departments that offered information revealed that 62.1% did not have a written response policy that suspends operations or response in extreme winds. Of the departments that had a written policy, 27.3% ceased those operations at a posted sustained wind speed between 25 and 49 mph, 54.4% ceased operations between 50 and 74 mph, and the remaining responses ceased at a sustained wind speed of between 75 and 99 mph.

Information gleaned from the survey revealed that all respondents had varying methods which were developed to make these wind response decisions. When surveyed to provide the criteria utilized to make a decision to cease response or operations, these responses ranged from the submission of "experience" to quoting National Fire Protection Association Standard 1921. Most stated a response that reflected an overall experience based decision making parameter without any written criteria to support the position.

A survey question was offered to gain information regarding the methods that were utilized to measure sustained wind speed information. The majority of the respondents, 33.3%, identified that this information was obtained from the local airport authority. In-house weather monitoring was utilized by 29.8% of the respondents. The media was used to make decisions 28.1% of the time. Local utility services were consulted 8.8% of the time, and the remainder of the respondents, 33.3%, listed "other" as the means to identify this critical information.

All survey responses indicated that a Command officer of some rank, from Fire Chief to Emergency Management Coordinator made the decision(s) to cease operations. Of the responses offered to this survey, 67.2% revealed that they did not have a public information program that identifies the suspension criteria to the public that is served within their jurisdiction. Of those that had a program in place to identify this information to the public, 18.8% felt that it was being effectively communicated to the citizens in their community.

Discussion

The 2008 study compiled by the International Association of Fire Chiefs asserts that it is paramount during hurricanes and tropical storms that a fire department "maintain a safe work environment for its firefighters and EMS personnel and provide essential emergency services to the public as long as the safety of the responders is not endangered by the storm conditions"

(IAFC, 2008). This admonishment, however, can provide difficulties to an Incident Commander regarding the appropriate criteria to suspend response or operational efforts. As was revealed in the research, approximately 62% of those that are making decisions do not have written criteria on which to base a decision to cease these efforts. Given the emotions involved in the desire to help those that are adversely affected by these extreme wind events, it can place the responders in a position of being exposed to the associated hazards, and potentially sacrificed unnecessarily (IAFC, 2008).

A 2006 study commissioned by the International Association of Fire Fighters identified that between the years of 2000 to 2005, 16% of firefighter related deaths were attributed to injuries sustained while operating in a natural disaster environment (Fisher et. al., 2006). This study directly relates to the potential for death and injury from emergency response during hurricanes, tornadoes, and flooding.

Research has identified the following guidelines be considered as potential benchmarks for making decisions based on identified sustained wind conditions. Personnel that are exposed to winds in excess of 39 to 46 miles per hour (mph) are placed in a position of risk when traveling on foot (Appendix B). From a vehicle response and travel perspective, passenger vehicles are adversely affected and begin to slide at wind speeds in excess of 71 mph and potentially overturn at a wind speed gust of 80 mph or greater (Greatrix, 2011).

It was discovered that wind speeds between 64 and 70 mph will cause a deviation in travel for a fire engine that has no equipment or water on board (Pirelli & Subramanian, 2003). Overturning of this type of unit is unlikely; however, a course deviation could cause a collision with another obstacle and cause the unit to overturn (Pirelli & Subramanian, 2003). Aerial ladder extension operations become dangerous and should be suspended when wind speeds reach 45 mph (Fisher, 2004).

Critical wind speeds can adversely impact ambulance operation when 35-50 mph is reached (Pirelli & Subramanian, 2003). These type units are at risk of overturning when wind speeds reach 90 mph and above (Pirelli & Subramanian, 2003). Travel speeds can affect this speed, and by slowing the response of the ambulance, it was found that the overturn speed increases to 100 mph (Pirelli & Subramanian, 2003). As with a fire engine, a course deviation can also cause a collision with another obstacle and cause the unit to overturn.

Sport utility vehicles become susceptible to high winds at 77 mph, with a risk of overturning at a wind speed of 138 mph (Pirelli & Subramanian, 2003). As with the other identified vehicles, these vehicles can also overturn at a lower rate of speed if a course deviation is experienced, or a collision occurs with another obstacle.

The wind speeds that are considered benchmarks for seeking shelter and suspending travel with fire engines and sport utility vehicles is 70 mph or greater, and 50 mph or greater for ambulances (Pirelli & Subramanian, 2003). The benchmark that should be considered to suspend passenger vehicle operation should be a sustained wind speed of 70 mph or greater (Greatrix, 2011).

Existing road conditions, debris, driver experience, and tire tread can impact all of the identified information positively or negatively. These aspects must be taken into account when making decisions regarding operational safety levels for the personnel involved while traveling to a call for service during high wind situations (Pirelli & Subramanian, 2003). Another aspect that can inhibit operational activities are the wind gusts which can be as much as 1.3 times faster than the sustained winds (Sheets & Williams, 2001).

Fire/EMS departments that were asked to provide the criteria utilized to make a decision to cease response or operations provided responses ranging from the submission of “experience” to quoting National Fire Protection Association Standard 1921. Most of the respondents stated an “experience” based decision parameter without any documented criteria to support this position.

An attempt was made in this research to gain information pertaining to the methods utilized to measure sustained wind speed information. There was no clear majority response to this question. One third of the respondents identified that this information was obtained from the local airport authority. Slightly less than one third of the respondents utilized in-house weather monitoring to provide wind information used to make response decisions. The media was consulted just less than one third of the time by response agencies. Local utility services were also consulted; however, this resource was utilized less than 10% of the time.

The National Weather Service provides “Spot Forecasting” meteorological information as an internet resource that can be useful to obtain specific sustained wind speed information for a given geographical area when making decisions regarding the manner of response (NWS, 2011). This specific source of information provides consistency to emergency response personnel when making decisions regarding sustained winds in an identified area (NWS, 2011).

All survey responses indicated that a Command officer of some rank, from Fire Chief to Emergency Management Coordinator made the decision(s) to cease operations. Of the responses offered to assist in this research, most agencies revealed that they did not have a public information program that identifies the suspension criteria to the public that is served within their jurisdiction. Of those that had a program in place to identify this information to the public, only 18% felt that it was being effectively communicated to the citizens in their community.

Recommendations

With the risk of injury and death that presents itself in high wind situations during hurricanes, it is paramount that Greenville Fire/Rescue, as well as Fire and EMS departments nationwide adhere to an accepted standard regarding suspension of operation and response during high wind conditions. The perspective that response personnel can always perform in these high risk environments must be reevaluated, and a standard must be established that provides for the safety of all personnel during an operational period while exposed to high winds. The National Incident Management System must also be utilized to ensure safety and accountability of all operational participants and continues to be the safety standard that all emergency response agencies should follow.

The specific standardized protocols from this author's perspective that should be followed in high wind operational environments are:

1. Cease personnel/staff exposure to sustained wind speeds of 40 mph or greater.
2. Cease all aerial ladder/platform operations at a sustained wind speed in excess of 45 mph.
3. Cease operation of ambulances at a sustained wind speed of 50 mph or greater.
4. Cease operation of fire apparatus, sport utility vehicles, and passenger vehicles at sustained wind speeds in excess of 70 mph.

With all the information gleaned from the research performed, a safe standard would involve suspending operations at any sustained wind speed of 40 mph or greater. This primarily relates to the associated hazards to personnel when sustained wind speeds are in excess of 40 mph. This is a fact based parameter and is justified with the information obtained in this research.

The remaining variable that was not clearly identified within this research is the method utilized to obtain a measurement of sustained wind speeds on a consistent basis. This source should be clearly identified within any written policy for any department that operates in high wind environments. This author's opinion is that departments should use the sustained wind information provided by the National Weather Service "Spot Forecasting" that gives emergency response agencies the most reliable, specific, and consistent data which will enable more accurate decisions to be made pertaining to suspending response to calls for service. This method, however, must be agreed upon by all agencies that would be involved in emergency response, as well as the responsible administrative staff, prior to a high wind event.

The final recommendation is the development of programs to provide information to the general public regarding the potential for suspending response to emergency calls at certain sustained wind speeds. As identified in this research, over 67% of survey responses from fire departments in North Carolina do not have a program of this type. These programs would provide awareness information pertaining to future high wind events so that any negative public perceptions or concerns could be addressed from a pre-event perspective. By making the public aware of the limitations of emergency services, citizens can prepare accordingly when making preparations prior to these high wind events occurring.

As previously stated North Carolina maintains a significant susceptibility to hurricanes and has a calculated risk of approximately 25% of receiving a major landfall from these type storms. The threat that presents itself is real and beyond the scope of most response agencies. It is paramount that preemptive action is taken through the development of written standards and policies, which will be adhered to by all emergency response agencies, to prevent the unnecessary loss of life or injury to emergency responders during operations in high winds.

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Appendix A

North Carolina Tropical Cyclone Statistics (1886 - 2005)

Statistic	**Direct Landfalling Tropical Cyclones in NC**	**Tropical Cyclones That Passed Through NC**
Number of Storms	28	82
Percentage of Storms	2.9	8.6
Average Number of Years Between Storms	4	1.3
Average Number of Storms Per Year	0.25	0.74

Appendix B

Beaufort Scale			
Observable Effects	**International Description**	**Beaufort Number**	**Wind Speed Miles/hour**
Air calm; smoke rises vertically	Calm	0	<1
Direction of wind shown by smoke drift but not by wind vanes	Light Air	1	1-3
Wind felt on face; leaves rustle; wind vanes moved by wind	Light Breeze	2	4-7
Leaves and small twigs in continual motion; wind extends light flags	Gentle Breeze	3	8-12
Raises dust, loose paper; moves small branches	Moderate Breeze	4	13-18
Small trees in leaf begin to sway; white crested wavelets form on inland waters	Fresh Breeze	5	19-24
Large branches in motion; umbrellas used with difficulty; telephone wires "whistle"	Strong Breeze	6	25-31
Whole trees in motion; inconvenience felt walking against wind	Moderate or Near Gale	7	32-38
Breaks twigs off trees; wind generally impedes progress	Gale or Fresh Gale	8	39-46
Slight structural damage occurs	Strong Gale	9	47-54
Trees uprooted; considerable structural damage occurs	Whole Gale or Storm	10	55-63
Widespread damage	Violent Storm	11	64-73
Devastation	Hurricane	12	>73

Appendix C

Saffir-Simpson Hurricane Scale

Category	**Barometric Pressure**	**Wind Speed**	**Storm Surge**	**Damage Potential**
1 (weak)	(980.2 mb or more)	(75 - 95 mph)	4 - 5 feet	Minimal damage to vegetation
2 (moderate)	(965.12 - 979.68 mb)	(96 - 110 mph)	6 - 8 feet	Moderate damage to houses
3 (strong)	(945.14 - 964.78 mb)	(111 - 130 mph)	9 - 12 feet	Extensive damage to small buildings
4 (very strong)	(920.08 - 944.8 mb)	(131 - 155 mph)	13 - 18 feet	Extreme structural damage
5 (devastating)	(< 920.08 mb)	(> 155 mph)	> 18 feet	Catastrophic building failures possible

Appendix D

1. Please provide your City and State Demographics.

City/ Town Various

State All 59 respondents were from North Carolina

2. Do you have a written policy that identifies when to cease aerial operations in high wind events?

- Yes 19.0%
- No 77.6%
- Not Sure 3.4%

3. If you have a policy that identifies when to cease aerial operations, what is the mile per hour-wind speed criteria utilized?

- 25-49 MPH 68.8%
- 50-74 MPH 25.0%
- 75-99 MPH 6.3%
- 100+ MPH 0%

4. Do you have a written policy that outlines when to cease all operations or response in high wind events?

- Yes 37.9%
- No 62.1%
- Not Sure 1.7%

5. If you have a policy, what wind speed criteria do you utilize to cease all operations/emergency response?

- 25-49 MPH 27.3%
- 50-74 MPH 54.5%
- 75-99 MPH 18.2%
- 100+ MPH 0%

6. If you have a written policy for the questions above, what criteria did you utilize to develop the policy?

24 Responses were offered.

7. How do you gain relevant information on sustained wind speeds in your community that is utilized for official decision making during a high wind event?

Media	28.1%
Local Airport	33.3%
Local Utilities	8.8%
In House Weather Monitoring	29.8%

8. Who makes the decision to cease operations in a high wind emergency? 54 Responses

9. Do you have a public information program that is utilized to convey information to your citizen population as to when operations/emergency response will cease?

Yes	29.3%
No	67.2%
Not Applicable	3.4%

10. If you have this public information program in place, has it been effective?

Yes	18.8%
No	4.2%
Not Applicable	58.3%
Not Sure	18.8%